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Field Monitoring of Treated Industrial Waste Water

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ABSTRACT

Discharge of untreated industrial water on land and in existing waterbodies has deteriorated the quality of these sources and has become harmful and disasterous for human as well as aquatic life..Many a times even treated industrial effluents are proved to be harmful. So in the project discussed below an effort has been made to test the treated industrial waste water and send the obtained results to the concerned industry as well as pollution control board. The sensor used to test the water were pH electrode (PE03), conductivity electrode (k=1), purity sensor, thermistor. The results obtained from the above sensors were then sent to the industry control room as well as pollution control board.using GSM.

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1. INTRODUCTION

The principal objective of testing the treated waste water is to check the purity, conductivity, pH and temperature of the water so that the water being disposed off from the water treatment plant can be used for household oragricultural purposes. The need of testing the treated industrial waste water arises because many a times the waste water of the industry is not treated properly due to improper ffunctioning of the treatment plants. This improper treatment causes damage to human as well as aquatic life. The treated water of the industries are dumped into rivers, large water bodies and are also used for irrigation purposes. If the water is not treated properly then it will cause disastrous effect to not only human life but also to the aquatic life. Irrigation with untreated or moderately treated wastewater and effluents might create ecological and human health hazards.

In the previous papers the affect of the industrial effluents on the aquatic life and human life have been discussed. It mainly points out on the need of further improvement in the industrial waste water treatment methods. The project being discussed below is based on testing of the treated industrial waste water. In this project the pH value, temperature of the water, conductivity of water and the visibility i.e. purity of the water will be tested for treated water of the industry and the results obtained will be send to the industry control room through ZigBee.

The following sensors are being used to test the treated water of the industry:

- pH electrode
- Temperature sensor
- Purity sensor
- Conductivity sensor

2. RELATED WORK

The impact of the discharge of the industrial effluents into the receiving water bodies in Nigeria resulted in the presence of high concentration of pollutants in the water and sediment. The pollutants were present in the concentration which may be toxic to different organisms. The purpose of this paper was to determine the impact of industrial effluents on the water quality of the receiving rivers in Nigeria and to aware people from the impact of the disposal of industrial effluents before pre-treatment [1].

Study on Physico-Chemical Parameters of Waste Water Effluents from Taloja Industrial Area of Mumbai was carried out which revealed that engineering, paper mill, fine chemical, dyes, paint, pharmaceutical, petrochemical and textile industries are some of the major industries which are responsible for polluting the surrounding aquatic environment. According to the observed results the pH value of the effluents samples collected from the above industries were either above or below the limit of 6.5 to 8.5. The contents of total dissolved solids, the chloride value, BOD, COD all were above the acceptable limits. These industrial effluents resulted in pollution of the Kasardi River thereby affecting the growth of vegetation and aquatic life. The results pointed out on the need to implement common objectives, and programmes for improvement in the industrial waste water treatment methods [2].

In another report, study of water quality at Mangrove islands was done. In this report the parameters tested for water quality were temperature, pH, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Turbidity, Total Suspended Solid (TSS), Total Organic Carbon (TOC) and Ammoniacal Nitrogen (NH3-N). It was found that the Air Hitam, Judah and Keluang rivers were experiencing contamination and pollution problems due to disposal of effluents from palm oil mill [3].

Considering the article published in The Times Of India newspaper on 29 march 2013 “Hundreds of fish died in highly contaminated Sutlej water” which states that due to the disposal of industrial waste water from Ludhiana into the Sutlej river hundreds of fish die in the river, apart from fishes the highly contaminated water also caused problems for the human beings living near the canals. The contaminated water is also flowing towards Rajasthan, where it is taking a toll especially on the farmers [4].

Taking into the consideration the recently published article in The Economic Times newspaper on 21 April 2013 “Lakhs of fish die in Kali Bein” which states that lakhs of fishes die due to reduced flow of fresh water and continuous flow of dirty water into Kali Bein. The polluted water from Kapurthala, as Sewerage Treatment Plant (STP) of the town was not working properly, as well as from some other villages and small towns was continuously flowing into it. Due to the the continuous flow of dirty water and reduced flow of fresh water, lakhs of fish die in the river. The dirty water i.e. the waste water which was not treated properly due to improper working of the sewerage plant, the polluted water from the villages and towns all together was dumped into the river [5].

3. SENSORS AND SPECIFICATIONS:

3.1. pH Electrode

The pH electrode is used to determine whether the solution or the water being tested is acidic, alkaline or neutral. pH is the important parameter as most of the chemical reactions in the aquatic environment are controlled by any variation in its value. Water with pH value of 10 or above reflects contamination by strong bases such as NaOH and Ca $(OH)_2$.

In this project, the electrode used is PE03 and its purpose is to determine the acidicity, alkalinity or the neutrality of the treated water of the industry. PE03 is a general purpose pH electrode whose pH range is 1 to 13 pH. Its measures are 12.3 mm diameter x 160 mm length.

pH electrode consist of an active electrode and a reference electrode. These two electrodes are physically combined into one electrode. A combinational electrode consist of a glass electrode which is surrounded by a concentric reference electrode. The reference electrode consists of a silver wire in contact with the approximately insoluble AgCl. Contact with the solution to be measured is via a KCl filling solution. To avoid mixing of the solution to be measured and the filling solution, a porous seal, the diaphragm, is used.

The pH probe being used produces a small voltage around 0.06 volt per pH unit. This voltage may vary solution to solution. This voltage is measured and is then send to ADC. The ADC converts it into digital form and send it to the microcontroller.

3.2. Conductivity Sensor

The conductivity sensor is used to measure the total ion concentration in the aqueous solution. It is used to measure the electrical conductivity of the solution. Conductivity probe is acally measuring the conductance that is inversely propotional to resistance.Conductivity is found using formula as below:

$$C = G * K_c$$

Where G = conductance and $K_{c=}$ Cell Constant.

Cell constant is determined by the formula as below:

$$K_c = d/A$$

D= distance between the two electrodes and A= area of the electrode surface.

The conductivity sensor being used in this project is of cell constant i.e. k=1.0. Conductivity probe consists of two parts anode and cathode. The distance between the two is fixed. When the potential difference is applied between the two electrodes the current is produced. The resulting current is propotional to the conductivity of the solution. This current is then converted into voltage which is further send to ADC for conversion.

The conductivity sensor used in the project has ABS body and has parallel graphite electrodes. Its dimensions are 12mm outer diameter and 150mm length. Its temperature range is from 0 to 89^0C.

3.3. Purity Sensor

The purity sensor being used in the project is self made sensor. It is inexpensive and easy to use. It includes LED (light emitting diode) and LDR (light dependent resistor). Both LED and LDR are sealed in a test tube so that water could not enter the test tube. Both are separated by the distance of 12cm and are inserted into the treated waste water. The light that is transmitted from the LED is received by the LDR. More is the light received by the LDR, more pure is the water.

The output voltage is converted into step size using formula:

Step size for 1V

$$X=\frac{256}{reference\ voltage}$$

Step size for the output voltage,

$$Z= X * output\ voltage \quad (1)$$

The value of Z is equal to the purity %.

3.4 Temperature Sensor

The temperature sensor being used in the project is thermistor. Thermistors are inexpensive, easy to use, adaptable and easily obtainable temperature sensors. These are constructed of semiconductor material with a resistivity that is sensitive to temperature.

A thermistor is a temperature dependent resistor. When temperature changes, the resistance of the thermistor changes. According to Ohm's Law resistance is directly propotional to voltage. Therefore, as the resistance changes voltage also changes.The change in voltage is measured and is send to the ADC for the conversion.

4. EXPERIMENTAL SETUP

The experimental setup generally includes a pH electrode, conductivity sensor, purity sensor, temperature sensor, ADC0808, microcontroller AT89S52, LCD and ZigBee. The main purpose of ADC is to convert the analog output of the sensors into the digital form and then send it to the microcontroller. The analog output is converted to digital form because microcontroller cannot process the analog output.ADC0808 is an 8 bit analog to digital convertor with 8 input analog channels. The input that is too converted into digital form can be selected with the help of three address lines. The voltage reference can be set by vref- and vref +. The step size is based on the set reference value. The default step size of the ADC is 19.53 mV with 5V as the reference voltage. Its conversion time is 100 μs. It works at 15mW.It needs external clock to operate.

The microcontroller AT89S52 is a low power, high performance CMOS 8-bit microcontroller having 8K bytes of in system programmable Flash memory. It has 256 bytes of RAM, 32 I/O lines, Watchdog timer, two data pointers, three 16 bit timers and counters, a six vector two level interrupt architecture, a full duplex serial port, on chip oscillator, and clock circuitry. The AT89S52 has static logic for operation down to zero frequency and supports two software selectable power saving modes. It has an endurance of 1000 write/erase cycles. It has programmable serial channel. At89S52 is ideal low power operatable and has power down modes.

ZigBee is a wireless technology developed as an open global standard to deal with the unique needs of low cost, low power wireless M2M networks. ZigBee is basically designed to communicate data through hostile RF environments that are usually common to industrial and commercial applications. It has low duty cycle i.e. it has long battery life, low latency. It has upto 65000 nodes per network. ZigBee networks are secured by 128 bit encryption keys. Its range is 100-300 Ft. The experimental setup is shown in figure 1 below:

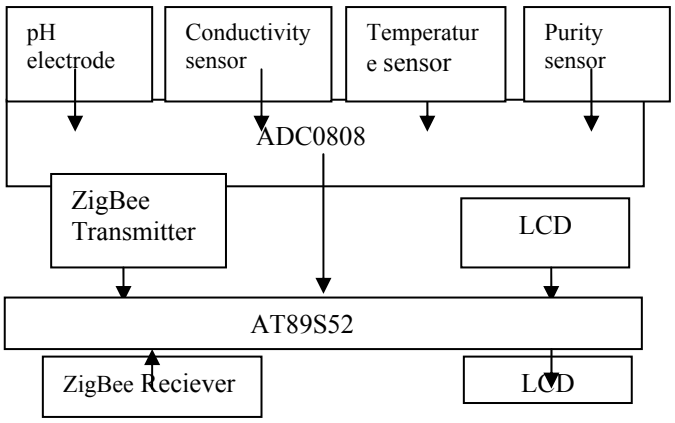

Figure 1. Block diagram of the experimental setup

To perform the experiment the treated waste water is taken. All the sensors are dipped into the water.

pH sensor is an active element it does not need any power supply. The electric potential will be created between the glass electrode and the reference electrode. This voltage will vary water to water. The obtained voltage is then sent to the ADC for conversion into digital form and is then sent to the microcontroller.

Conductivity sensor when immersed into the solution will put force on to the charged ions in the water which pushes them to either cathode or anode. The flow of ions in the solution will cause current to flow. This current is propotional to the conductivity of the solution. Further the current is converted into voltage. This voltage is send to ADC for conversion which is further send to microcontroller.

Purity sensor will check the amount of light received by the LDR ie amount of voltage received. The output voltage is then sent to the ADC. Step size of ADC is 256. The output voltage is then converted into the step size which is equal to the purity %. The computed value is then sent to the microcontroller.

Temperature sensor used in this project is thermistor. Thermistor is a temperature dependant resistor. With the change in the temperature, the resistance of the thermistor changes. As we know, resistance and voltage are directly propotional to each other. Therefore with the change in resistance voltage will also change.This change in voltage will be measured and will be send to ADC. ADC will convert it into digital form and will further send it to microcontroller.

5. RESULTS

The setup is tested for 6 days and each day the treated industrial water has been changed. The monitored results of each day after testing is shown below:

Table 1. Obtained Results

Days	pH	Conductivity (%)	Purity (%)	Temperature(centigrades)
1	8	67	88	16
2	9	69	90	17
3	8.2	72	87	16
4	7.9	75	89	18
5	7.5	78	91	17
6	8.5	71	86	16

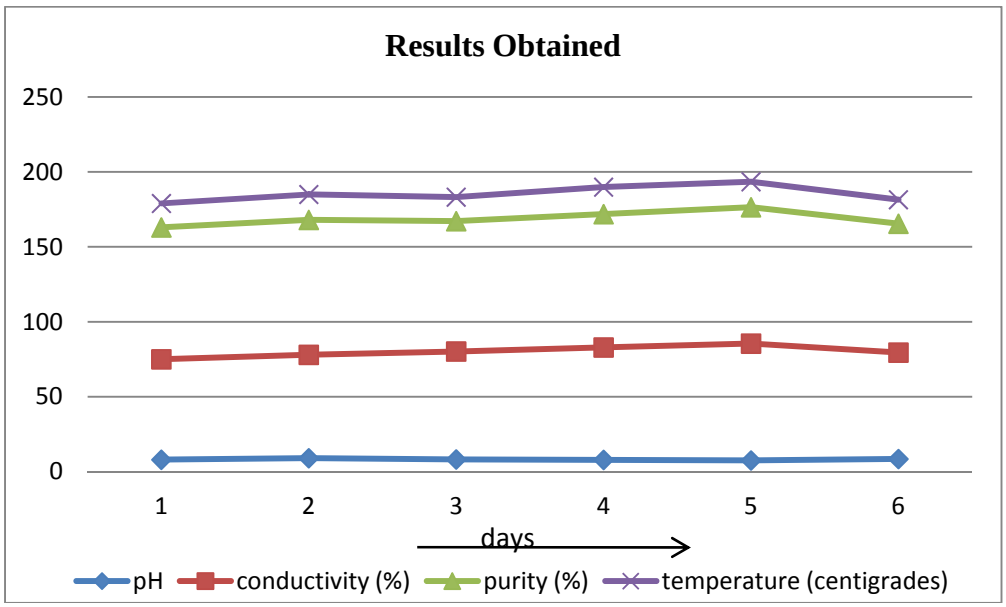

Figure 2. Graph for Obtained Results

6. CONCLUSION

With the growing industrialisation water as well as air pollution is also increasing. Therefore, only treating the industrial waste water is not enough. So an effort has been made to test the treated industrial waste water. Test for pH, conductivity, purity, TDS and temperature has been performed on the water from the treatment plant of the leather industry. After testing the treated water conclusion has been made that the values of the parameters (being considered) changes according to the effluents left in the water. More the impurity in water, more is its conductivity. The value of pH, purity and TDS also changes if the water is not treated properly.

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Vasudha Bhandari is pursuing her M-tech thesis in Electronic Product Design and Technology in C-DAC Mohali. Her field of Interest are VHDL, Control systems, Embedded System Designing, MATLAB, C, C++.

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